

**ANTARCTIC ANALOG FOR A PERENNIAL ICE-COVERED PALEOLAKE IN GUSEV CRATER (MARS), E.A. GRIN, AND N.A. CABROL, NASA Ames Research Center, Space Science Division, MS 245-3, Moffett Field, CA 94035-1000**

The dimension of Gusev crater and its morphologic records allowed to infer: 1) a bathymetric model of Gusev lakes; 2) the existence of a former lake (or series of lakes) in Gusev before the entry of Ma'adim Vallis in the crater. 3) morphologic similarities between Ma'adim Vallis deltaic structure and terrestrial Antarctic model.

Our bathymetric model is based on Viking topographic data [1]. Variations of the paleolakebed area are expressed as a function of the lake-level elevation and corresponding water volumes (*see table* ). The lake volume is minimized for the crater bottom elevation (-500 m). The result gives a 500 m sediment thickness, relatively to the present floor elevation, in good agreement with the geometrical excavated volume of Ma'adim Vallis [2]. It also shows an ancient and deep lake-level in Gusev: a 2500 m rim-to-bottom distance provided a sufficient hydraulic head to drain the surrounding subsurface aquifer and to generate a former lake. This aquifer may have been recharged with surface water by the infiltration of Ma'adim Vallis flood plain. During this period, the fluvial valley was not yet confined [3,4 ] and did not enter the crater [4 ], though part of the flood plain may have been drained by small channels inside Gusev [5]. Thus, the former lake, that could have been generated very early after the formation of Gusev during the Noachian period, was sustained both by surface small runoff channel networks, infiltration, and aquifer gravity drainage. Its life duration depended on the variation of each of the water sources. The heat flux provided by the melt sheet of Gusev brecciated material may have allowed to maintain water in liquid state through climatic changes. Ice was likely an element that helped the conservation of the lake water [6]. To support this hypothesis, Ma'adim Vallis delta shows morphologic similarities with the relic-subglacial delta of the outer continental shelf off in the Antarctic Peninsula (Anvers Isl.) [7]. Ma'adim Vallis delta displays leveled flat-topped mesas furrowed by deep diverging channels, and presents a steep-walled foreset. The seaward steep front of the Antarctic delta is the result of a proximal off shore deposition. Its flat topset is overlapped by unstratified layers indicative of a subice deposition [7]. These morphologic similarities between the Martian and the Antarctic delta can only be explained if Ma'adim Vallis delta was formed under water, thus that there was already a lake inside Gusev when the confined valley entered it, and that this lake was ice-protected [6]. Thus, the results of this study support the hypothesis of an active lacustrine activity in Gusev crater from the Noachian to the Amazonian [5,8]. Most important is the fact that the existence of this lake is not related only to the influx of Ma'adim Vallis, but also to a subsurface aquifer potentially sustained by a hydrothermal and volcano/ground ice activity generated by numerous regional volcanic structures. These results make Gusev crater one of the most favorable Martian sites in the perspective of exobiology exploration.

Table: bathymetric model of Gusev lake<sup>a</sup>

| Water level elevation (m) | Area (km <sup>2</sup> ) | Water volume between two levels (km <sup>3</sup> ) | Lake water volume (cum. km <sup>3</sup> ) |
|---------------------------|-------------------------|--|---|
| 1000                      | 15 400                  | 6500   | 11 280                                    |
| 500                       | 11 000                  | 3.900  | 4 730                                     |
| 0                         | 5 000                   | 830  | 830                                       |
| -500                      | 0                       |  | 0   |

<sup>a</sup> volume of sediment deposition not included

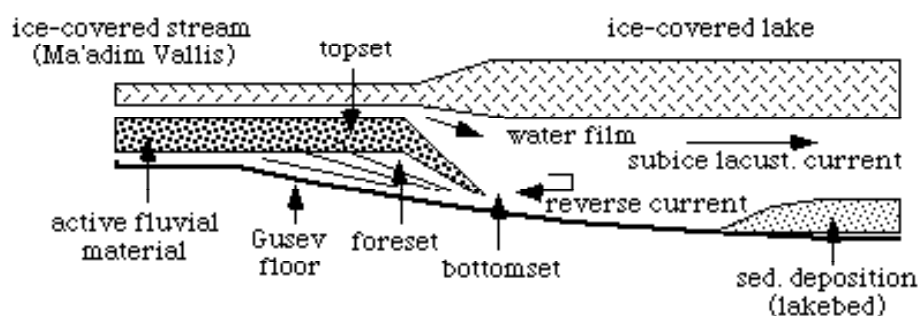
# GUSEV CRATER PALEOLAKE, E.A. GRIN, and N.A. CABROL

Acknowledgments: This study was financially supported by the National Research Council grant for the second author.

## References:

[1] USGS I-2119, I-2120 (1991); [2] Cabrol *et al.* (1996), *Icarus* 123, 269-283.; [3] Landheim *et al.* (in progress); [4] Cabrol and Grin (this LPSC); [5] Kuzmin *et al.* (in progress); [6] Chapman, M. (1994) *Icarus* 109, 393-406; [7] Later R.D., and L.E.Vanneste (1995) *Geology* 23, 33-36; [8] Grin E.A., and N.A. Cabrol (submitted to *Icarus*).

## 1 - Subice Delta Model in Gusev Crater



## 2 - Shoreline Level and Sediment Evolution in Time

